MODELLING AND FORECASTING UNEMPLOYMENT RATES IN NIGERIA USING ARIMA MODEL

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Abstract: Unemployment rate is a big macroeconomic issue of our time. Unemployment disrupts lives and is associated with an irrecoverable loss of real output. This paper aims to modeling and forecast the evolution of unemployment rates in Nigeria using ARIMA model on annual data for the period of 1972 to 2014. The Augmented Dickey-Fuller (ADF) test for unit root was carried out on the unemployment rate time series, the result revealed a stationary time series at first difference. The empirical study revealed that the most adequate model for modelling and forecasting the unemployment rates within this period in Nigeria is ARIMA (2,1,2). The forecast of unemployment rate in Nigeria revealed an increasing rate from 2015 to 2017 while a slight decrease in 2018. During this period of 2015 to 2018 unemployment rates is still very high in Nigeria. This present administration should focus on capital project that has the capacity to create employment.

Keywords: ARIMA, forecast, unemployment rates, ADF unit roots test, macroeconomic

Introduction

Unemployment rate is a big macroeconomic issue of our time (Lipsey & Chrystal, 1999). Unemployment disrupts lives and is associated with an irrecoverable loss of real output. In situation of excessive labour supply, it would be difficult for workers to find employment and unemployment would be at high levels (Furuoka, 2008). Furuoka (2008) studied the interrelation between unemployment and inflation in the Philipines using Vector Error Correction Model (VECM).

Unemployment according to Bryne & Strobl (2001) and Adeyi (2012) remain considerable theoretical debate regarding the causes, consequences and solution. Adeyi (2012) reveal that Classical and Neoclassical economists argue that unemployment is a result of intervention imposed on the labour market from outside, and that market mechanisms are the reliable means of resolving the problem of unemployment. Keynesian economists emphasize the clinical nature of unemployment and recommends interventions as the solution especially during recessions.

Msigwa & Kipesha (2013) examined the factors which determine youth unemployment (such as education system, lack of skills in business, etc.) in Tanzania and suggested way forward (such as the government and policy makers should review job market laws and regulation in order to promote smooth transition of youth from education to job market) in order to reduce of unemployment problem. Vodopivec (2009) examined and suggested unemployment insurance as a common public income support program for the unemployed in developing countries.

In Nigeria, unemployment is a big problem plaguing the economy that is why many researches have been tailored toward resolving and solving unemployment in Nigeria. For example, Ejikeme (2014) studied unemployment and poverty in Nigeria as it relate to National insecurity. Aminu *et al.* (2003) revealed the fact that the rate of unemployment, poverty, corruption and inflation in Nigeria is alarming despite government efforts to reduce them; Bula (2014) studied the relationship between inflation, employment and economic growth in Nigeria from 1970 to 2012. Bula recommended the need to improve understanding of the relationships between unemployment and growth to ensure that growth generates positive and significant employment elasticity.

The aim therefore of this paper is to estimate the most adequate ARIMA model of unemployment rate in Nigeria for the period of 1972 to 2014 under the assumption that present unemployment rates depend on the unemployment rate of previous year. Also to recommend how unemployment rate can be curtail in Nigeria.

Model Specification

Stationarity test

A stationary time series are so important in order to avoid spurious regression (Yule, 1926; Granger and Newbold, 1974). Although there are several tests for testing stationarity, the unit root test will be adopted.

A test of stationarity (or non stationarity) that has become widely popular over the past several years is the unit root test. To distinguish a unit root, we can run the regression

$$\Delta Y_t = b_o + \sum_{j=1}^{k} b_j \Delta Y_{t-j} + \beta t + \gamma Y_{t-1}\ u_t$$

The model may be run without t if a time trend is not necessary. If there is unit root, differencing Y should result in a white-noise series (no correlation with Y_{t-1}).

The Augmented Dickey-Fuller (ADF) test of the null hypothesis of no unit root tests; H_o: $\beta = \gamma = 0$ if there is trend (we use F-test) and H_o: $\gamma = 0$ if there is no trend (we use t-test). If the null hypothesis is accepted, we assume that there is a unit root and difference the data before running a regression. If the null hypothesis is rejected, the data are stationary and can be used without differencing (Salvatore & Reagle, 2002).

ARIMA model and estimation

ARIMA model is an approach that combines the moving average and the autoregressive models (Dobre & Alexandru, 2008). The pioneers in this area were Box and Jenkins popularly known as the Box-Jenkins (BJ) methodology, but technically known as the ARIMA methodology (Gujarati, 2003). The emphasis of these methods is not on constructing single-equation or simultaneous-equation models but on analyzing the probability, or stochastic, properties of economic time series on their own under the philosophy 'let the data speak for themselves'. Unlike the regression models, in which Y_t is explained by k regressor $X_1, X_2 \dots X_k$, the BJ-type time series models allow Y_t to be explained by past, or lagged, values of y Y itself and stochastic error terms. For this reason, ARIMA Models are sometimes called atheoretic models because they are not derived from any economic theory.The Box-Jenkins ARMA (p,q) model is a combination of the AR and MA model as follows (Table 1);

$$y_t = a_o + a_1 y_{t-1} a_2 y_{t-2} + ... + a_p y_{t-p} - b_1 u_{t-1} - b_2 u_{t-2} - ... - b_q u_{t-q} + u_t$$

Box and Jenkins recommend difference non-stationary series one or more times to achieve stationarity. Doing so produces an ARIMA model, with the 'I' standing for 'Integrated'. But its first difference $\Delta y_t = y_t - y_{t-1} = u_t$ is stationary, so y is 'Integrated of order 1' or y~I(1).

There are three primary stages in building a Box-Jenkins time series model; they are model identification; model estimation and model validation.

Table 1: Theoretical patterns of ACF and PACF

Type of model	Typical pattern of ACF	Typical pattern of PACF
AR(p)	Decays exponentially or with damped sine wave pattern or both	Significants spikes through lags p
MA(q)	Significants spikes through lags p	Declines exponentially
ARMA(p,q)	Exponentially decay	Exponentially decay

A test for adequacy of the fitted model is the chi-squared test for goodness of fit called Ljung-Box test (Ljung & Box, 1978). This test is based on all the residual ACF as a set. The test statistic is given as $Q = n(n+2)\sum_{i=1}^{k}(n-i)^{-1}\gamma_i^2(\hat{a})$ where $\gamma_i^2(\hat{a})$ is the estimate for $\rho_j(\hat{a})$ and n is the number of observations used to estimate the model. The statistic Q follows approximately a chi-squared distribution with k-v degrees of freedom, where v is the number of parameters estimated in the model. If we accept the null hypothesis, it implies that the model fitted will be adjudged to be adequate.

ARIMA modelling has been discussed in Kendall and Ord (1990); Adekeye and Aiyelabegan (2006); Dobre and Alexandru (2008); Box *et al*. (1994); Gujarati (2003); Shangodoyin and Ojo (2002).

Materials and Methods

The data used in this paper was sourced from Bula (2014) and Eme (2014). The data on annual unemployment rate in Nigeria is on percentage that spanned from 1972 to 2014. The data is presented in Appendix.

Results and Discussion

The first step in building time series models entails a detailed analysis of the characteristics of the individual time series variables involved (Adenomon, 2016). Some important characteristics of time series can be through the time series plot or time plot. The data for the paper is presented in the time plot in Fig. 1 in the Appendix. It is observed that unemployment rates in Nigeria had a steady increase from 2004 to 2014.

The modelling and forecasting of unemployment rates in Nigeria was carried using Eviews 7 and MINITAB statistical software. This section begins with Augmented Dickey-Fuller (ADF) unit root testing of the unemployment rate. The result revealed that unemployment rates in Nigeria is stationary at first difference with P-values <0.05 for ADF test for intercept only and, intercept and trend. Detail is presented in Appendices 2 and 3.

The result for stationarity of the time series variable has been established, then we need to study the theoretical pattern of the time series using the Autocorrelation Function (ACF) and Partial Autocorrelation Function (ACF), in order to know if the time series follows an ARIMA model. The ACF and PACF are presented in Figs. 2 and 3 in the Appendix revealed that both are exponentially decayed, revealing that unemployment rate in Nigeria can be better explained using ARIMA model.

ARIMA–modeling and forecasting

In the earlier part of this section it was established that unemployment is stationary at first difference which means that the parameter d=1in our ARIMA model. The possible ARIMA models were considered with their respective Mean Square Error (MSE) in Table 2. The minimum MSE of 7.944 is associated with ARIMA (2,1,2) model. This means that ARIMA (2,1,2) model is best in modeling and forecasting unemployment rates in Nigeria within the period under consideration.

Table 2: Possible ARIMA models for unemployment rates in Nigeria

ARIMA models	MSE
(1,1,1)	8.109
(2,1,2)	**7.944***
(2,1,1)	8.358
(1,1,2)	8.012

*Minimum MSE

In Appendix 4, the detail of the ARIMA (2,1,2) model is presented in the appendix. The parameters for the Autoregressive (AR) and Moving Average (MA) are significant at all levels of Significance (p-values=0.000). The result from Ljung-Box Chi-square statistic revealed that the ARIMA (2,1,2) model is adequate at Lags 12, 24, and 36. This implies that the model is suitable for forecast.

Table 3: Forecast of unemployment rates in Nigeria from 2015 to 2018

		95 Percent Limits	
Period	**Forecast**	**Lower**	**Upper**
2015	29.7852	24.2598	35.3107
2016	32.2485	24.8232	39.6739
2017	32.5856	23.6539	41.5172
2018	31.6983	21.1985	42.1981

The forecast of unemployment rates in Nigeria from 2015 to 2018 is presented in Table 3. The forecast of unemployment rates in Nigeria revealed an increasing rate from 2015 to 2017 while a slight decrease in 2018. During this period of 2015 to 2018 unemployment rates is still very high. This result is similar to the result of Eme, (2014).

Post ARIMA analysis

The post ARIMA analysis is suitable in examining the stability of the model. In Figs. 4 and 5 (in Appendix), the ACF and PACF of the residual are presented in the appendix. In this Figures the values of the ACF and PACF lies within the 5% significance limits. This implies that the ARIMA model is stable. In Fig. 6 presented in the Appendix, the residuals of the ARIMA model is normally distributed which signify that the ARIMA model is stable and adequate.

Summary of results

This paper attempted to model unemployment rates in Nigeria using ARIMA model. The ADF test revealed that the unemployment rates time series variable is stationary at first difference for intercept only and, intercept and trend at all levels of significance. The ACF and PACF analysis revealed that the model follows an Autoregressive Integrated Moving Average (ARIMA). Four possible ARIMA models were considered in the modeling of unemployment rates in Nigeria, the result revealed that ARIMA (2,1,2) is the adequate model suitable for modelling of unemployment rates in Nigeria within this period under consideration. The forecast of unemployment rates in Nigeria from 2015 to 2018 was obtained using the ARIMA (2,1,2). The forecast of unemployment rates in Nigeria revealed an increasing rate from 2015 to 2017 while a slight decrease in 2018. During this period of 2015 to 2018, unemployment rates is still very high. This result is similar to the result of Eme (2014). The analysis of the post ARIMA model revealed that the model is adequate and stable.

Conclusion and Recommendations

The National unemployment rates in Nigeria from 1972 to 2014 can be modeled and forecasted using ARIMA (2,1,2) model.

This paper recommends the following:

i. This present administration should focus on capital project that has the capacity to create employment.
ii. The government should ensure political stability and peaceful atmosphere in order to attract foreign investors to create more jobs.
iii. The government should help empower small and medium scale businesses through soft loans. So through this medium more jobs can be created.
iv. Entrepreneurship education should be intensified in our tertiary institution, so that graduate can be self-reliance.

References

Adekeye KS & Aiyelabegan AB 2006. Fitting an ARIMA Model to Experimental Data.*Nigerian Statistical Association (NSA) Conference Proceedings*, pp. 65 – 72.

Adenomon MO 2016. *An Introduction to Univariate and Multiple Time Series Analysis wit Examples in R*, Jube-Evans Books and Publications, Niger State, Nigeria, p. 8.

Adeyi EO 2012. Unemployment and Inflation in Nigeria: An Empirical Investigation. *Economic Dynamics & Policies*, 85 - 88.

Aminu U, Manu D, El-Maude JG & Kabiru MY 2013. Relationship between crime level, unemployment, poverty, corruption and inflation in Nigeria (An empirical analysis). *Glo. Adv. Res. J. Mgt. Bus. Stud*., 2(8): 411-422.

Box GEP, Jenkins GM & Reindel GC 1994. *Time Series Analysis, Forecasting and Control,* 3rd edn. Prentice-Hall, Inc., New Jersey, pp. 89–96.

Bula YB 2014. The Relationship between Inflation, Employment and Economic Growth in Nigeria: 1970-2012. M.Sc Thesis, Ahmadu Bello University, Zaria.

Byrne D & Strobl E 2001. Defining Unemployment in Developing Countries: The Case of Trinidad and Tobago. CREDIT Research Paper No. 01/09. University of Nothingham.

Dobre I & Alexandru AA 2008. Modelling unemployment rate using Box-Jenkins procedure. *J. Appl. Quantit. Methods*, 3(2): 156 – 166.

Ejikeme JN 2014. Unemployment and poverty in Nigeria: A link to national insecurity. *Global J. Politics & Law Res*., 2(1): 19 - 35.

Eme OI 2014. Unemployment Rate in Nigeria: Agenda for Government. *Acad. J. Interdis. Studies,* 3(4): 103 - 114.

Furuoka F 2008. Unemployment and inflation in the Philippines. *Philippine J. Dev.*, XXXV(1): 93 - 106.

Granger CWJ & Newbold P 1974. "Spurious regressions in econometrics". *Journal of Econometrics*, 2: 111 120

Gujarati DN 2003. *Basic Econometrics,* 4th edn. The McGraw-Hill Co, New Delhi, pp. 835 – 848.

Kendall M & Ord JK 1990. *Time Series,* 3rd edn. Edward Arnold ,Great Britain, pp. 104 – 120.

Lipsey RG & Chrystal KA 1999. *Principles of Economics*, 9th edn. Oxford University Press, United States. pp. 529 – 544.

Ljung GM & Box GEP 1978. On a Measure of Lack of Fit in Time Series Models. *Biometrika* 69: 297 - 303.

Msigwa R & Kipesha ER 2013. Determinants of youth unemployment in developing countries: Evidence from Tanzania. *J. Eco. & Sust. Dev.,* 4(14): 67 – 76.

Salvatore D & Reagle D 2002. *Schaum's Outline of the Theory and Problems of Statistics and Econometrics,* 2nd edn. McGraw-Hill Company, New York, pp. 242 – 248.

Shangodoyin DK & Ojo JF 2002. *Elements of Time Series Analysis*. Rashed Publications Ltd, Ibadan, pp. 34 – 59

Vodopivec M 2009. Introducing Unemployment Insurance to Developing Countries. SP Discussion Paper No. 0907. The World Bank.

Yule GU 1926. Why do we sometimes get nonsense correlation between time series? A study in sampling and the nature of time series. *J. Royal Stat. Soc.*, 89: 1 - 64.

APPENDICES

Appendix 1: Annual data on unemployment rate in Nigeria from 1972 to 2014

Year	Unemployment Rate (%)	year	Unemployment Rate (%)
1972	2	1994	2
1973	3.2	1995	1.8
1974	6.2	1996	3.4
1975	4.8	1997	3.2
1976	4.3	1998	3.2
1977	4.3	1999	3
1978	4.3	2000	18.1
1979	4.3	2001	13.7
1980	6.4	2002	12.2
1981	6.4	2003	14.8
1982	6.4	2004	11.8
1983	6.4	2005	11.9
1984	6.2	2006	13.7
1985	6.1	2007	14.6
1986	5.3	2008	14.9
1987	7	2009	19.7
1988	5.3	2010	21.1
1989	4.5	2011	23.9
1990	3.5	2012	24.3
1991	3.1	2013	28.5
1992	3.4	2014	30
1993	2.7		

Sources: Bula, (2014) and Eme, (2014)

Appendix 2: ADF test for stationarity (intercept only)

Null Hypothesis: D(UNEMPLOY) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on AIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.748457	0.0000
Test critical values:	1% level	-3.600987	
	5% level	-2.935001	
	10% level	-2.605836	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMPLOY,2)
Method: Least Squares
Date: 06/08/16 Time: 18:13
Sample (adjusted): 1974 2014
Included observations: 41 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UNEMPLOY(-1))	-1.213060	0.156555	-7.748457	0.0000
C	0.791368	0.456923	1.731949	0.0912

R-squared	0.606214	Mean dependent var	0.007317
Adjusted R-squared	0.596117	S.D. dependent var	4.489398
S.E. of regression	2.853093	Akaike info criterion	4.982235
Sum squared resid	317.4654	Schwarz criterion	5.065824
Log likelihood	-100.1358	Hannan-Quinn criter.	5.012673
F-statistic	60.03859	Durbin-Watson stat	2.025821
Prob(F-statistic)	0.000000		

Appendix 3:ADF test for stationarity (intercept and trend)

Null Hypothesis: D(UNEMPLOY) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on AIC, maxlag=1)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.141356	0.0000
Test critical values:	1% level	-4.198503	
	5% level	-3.523623	
	10% level	-3.192902	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMPLOY,2)
Method: Least Squares
Date: 06/08/16 Time: 18:15
Sample (adjusted): 1974 2014
Included observations: 41 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UNEMPLOY(-1))	-1.267322	0.155665	-8.141356	0.0000
C	-0.617383	0.918845	-0.671913	0.5057
@TREND(1972)	0.065628	0.037444	1.752703	0.0877

R-squared	0.635667	Mean dependent var	0.007317
Adjusted R-squared	0.616492	S.D. dependent var	4.489398
S.E. of regression	2.780196	Akaike info criterion	4.953276
Sum squared resid	293.7207	Schwarz criterion	5.078659
Log likelihood	-98.54215	Hannan-Quinn criter.	4.998933
F-statistic	33.15012	Durbin-Watson stat	2.091365
Prob(F-statistic)	0.000000		

Appendix 4: ARIMA (2,1,2) Model: Unemployment Rate

Estimates at each iteration

Iteration	SSE	Parameters				
0	333.253	0.100	0.100	0.100	0.100	0.613
1	319.416	-0.003	0.067	0.202	0.133	0.581
2	318.285	-0.153	0.066	0.054	0.161	0.678
3	317.161	-0.303	0.059	-0.095	0.182	0.781
4	314.148	-0.294	-0.084	-0.082	0.032	0.875
5	311.068	-0.299	-0.228	-0.085	-0.118	0.980
6	308.126	-0.329	-0.376	-0.111	-0.268	1.102
7	305.773	-0.394	-0.526	-0.173	-0.413	1.252
8	304.561	-0.544	-0.619	-0.319	-0.473	1.423
9	304.197	-0.524	-0.684	-0.304	-0.553	1.457
10	304.047	-0.575	-0.712	-0.365	-0.571	1.510
11	303.888	-0.551	-0.757	-0.346	-0.635	1.524
12	303.809	-0.592	-0.771	-0.397	-0.640	1.563
13	303.747	-0.564	-0.788	-0.370	-0.673	1.555
14	303.660	-0.593	-0.802	-0.407	-0.681	1.586
15	303.603	-0.584	-0.818	-0.401	-0.707	1.590
16	303.566	-0.599	-0.825	-0.420	-0.709	1.605
17	303.530	-0.591	-0.837	-0.414	-0.730	1.607
18	303.497	-0.612	-0.845	-0.441	-0.731	1.628
19	303.479	-0.600	-0.844	-0.426	-0.733	1.617
20	303.457	-0.589	-0.863	-0.423	-0.764	1.621
21	303.369	-0.630	-0.875	-0.473	-0.765	1.663
22	302.991	-0.616	-0.908	-0.463	-0.817	1.672
23	302.076	-0.655	-0.938	-0.523	-0.843	1.724
24	300.242	-0.658	-0.966	-0.534	-0.883	1.742
25	296.225	-0.669	-0.989	-0.567	-0.921	1.773

** Convergence criterion not met after 25 iterations **

* WARNING * Back forecasts not dying out rapidly

Back forecasts (after differencing)

Lag -97 - -92	1.519	0.186	0.132	1.517	0.633	-0.169
Lag -91 - -86	1.268	1.107	-0.238	0.835	1.469	-0.046
Lag -85 - -80	0.339	1.611	0.361	-0.080	1.483	0.870
Lag -79 - -74	-0.296	1.114	1.339	-0.239	0.601	1.629
Lag -73 - -68	0.083	0.090	1.649	0.586	-0.271	1.384
Lag -67 - -62	1.131	-0.372	0.902	1.560	-0.175	0.334
Lag -61 - -56	1.744	0.275	-0.157	1.622	0.854	-0.425
Lag -55 - -50	1.218	1.400	-0.385	0.639	1.751	-0.038
Lag -49 - -44	0.048	1.800	0.527	-0.384	1.521	1.152
Lag -43 - -38	-0.525	0.983	1.659	-0.324	0.335	1.895
Lag -37 - -32	0.172	-0.239	1.782	0.830	-0.570	1.341
Lag -31 - -26	1.463	-0.553	0.688	1.887	-0.180	0.007
Lag -25 - -20	1.972	0.452	-0.507	1.680	1.169	-0.697
Lag -19 - -14	1.083	1.766	-0.497	0.344	2.064	0.049
Lag -13 - -8	-0.327	1.966	0.793	-0.732	1.487	1.528
Lag -7 - -2	-0.744	0.753	2.037	-0.347	-0.032	2.167
Lag -1 - 0	0.360	-0.641				

Back forecast residuals

Lag -97 - -92	0.019	-0.015	-0.025	0.043	0.004	-0.061
Lag -91 - -86	0.038	0.049	-0.080	-0.003	0.095	-0.062
Lag -85 - -80	-0.066	0.113	-0.003	-0.122	0.085	0.075
Lag -79 - -74	-0.141	0.014	0.141	-0.108	-0.077	0.164
Lag -73 - -68	-0.028	-0.153	0.131	0.072	-0.183	0.047
Lag -67 - -62	0.158	-0.153	-0.062	0.198	-0.068	-0.158
Lag -61 - -56	0.174	0.046	-0.208	0.091	0.152	-0.193
Lag -55 - -50	-0.026	0.213	-0.116	-0.140	0.210	0.002
Lag -49 - -44	-0.214	0.141	0.123	-0.224	0.026	0.210
Lag -43 - -38	-0.166	-0.101	0.235	-0.055	-0.200	0.190
Lag -37 - -32	0.075	-0.242	0.087	0.186	-0.212	-0.045
Lag -31 - -26	0.244	-0.119	-0.166	0.232	0.012	-0.241
Lag -25 - -20	0.151	0.142	-0.248	0.024	0.234	-0.182
Lag -19 - -14	-0.113	0.260	-0.061	-0.221	0.211	0.080
Lag -13 - -8	-0.267	0.100	0.202	-0.237	-0.044	0.269
Lag -7 - -2	-0.138	-0.178	0.260	0.004	-0.266	0.176
Lag -1 - 0	0.150	-0.279				

Final Estimates of Parameters

Type	Coef	SE Coef	T	P
AR 1	-0.6693	0.0552	-12.11	0.000
AR 2	-0.9885	0.0509	-19.42	0.000
MA 1	-0.5670	0.1211	-4.68	0.000
MA 2	-0.9207	0.1106	-8.32	0.000
Constant	1.773	1.082	1.64	0.110

Differencing: 1 regular difference
Number of observations: Original series 43, after differencing 42
Residuals: SS = 293.933 (backforecasts excluded)
MS = 7.944 DF = 37

Modified Box-Pierce (Ljung-Box) Chi-Square statistic

Lag	12	24	36	48
Chi-Square	7.4	14.3	17.1	*
DF	7	19	31	*
P-Value	0.387	0.764	0.980	*

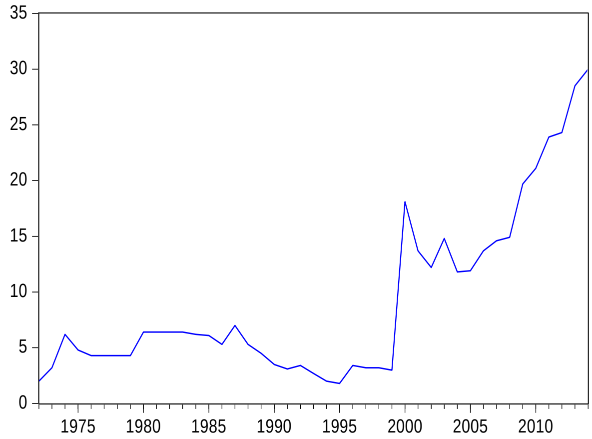

Fig 1: Annual unemployment rate in Nigeria from 1972 to 2014

Autocorrelation Function: Unemployment

Lag	ACF	T	LBQ
1	0.829617	5.44	31.71
2	0.697266	2.97	54.65
3	0.611138	2.19	72.72
4	0.494699	1.60	84.86
5	0.398090	1.22	92.93
6	0.320367	0.95	98.30
7	0.272307	0.79	102.29
8	0.222233	0.64	105.02
9	0.190880	0.54	107.09
10	0.156359	0.44	108.52
11	0.122934	0.34	109.44

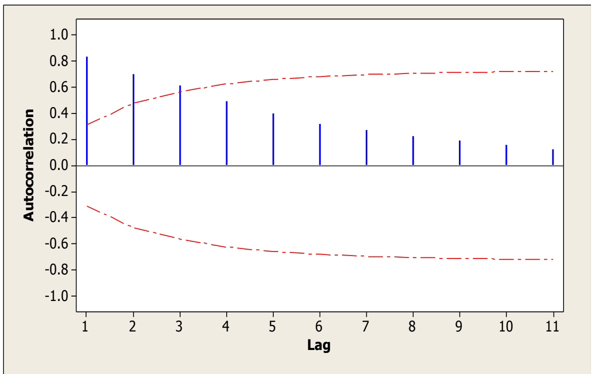

Fig. 2: Autocorrelation Function for Unemployment
(with 5% significance limits for the autocorrelations)

Partial Autocorrelation Function: Unemployment

Lag	PACF	T
1	0.829617	5.44
2	0.028873	0.19
3	0.081619	0.54
4	-0.123551	-0.81
5	-0.008469	-0.06
6	-0.017155	-0.11
7	0.065970	0.43
8	-0.027279	-0.18
9	0.038865	0.25
10	-0.043734	-0.29
11	-0.005039	-0.03

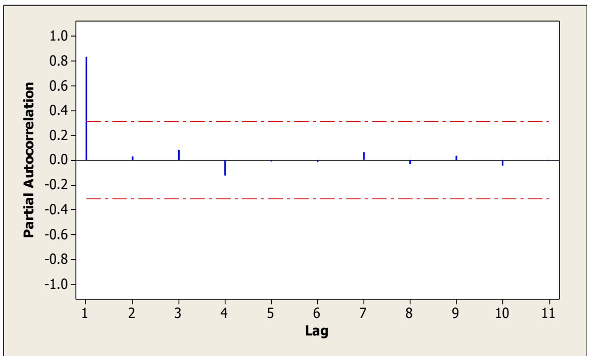

Fig. 3: Partial Autocorrelation Function for Unemployment
(with 5% significance limits for the partial autocorrelations)

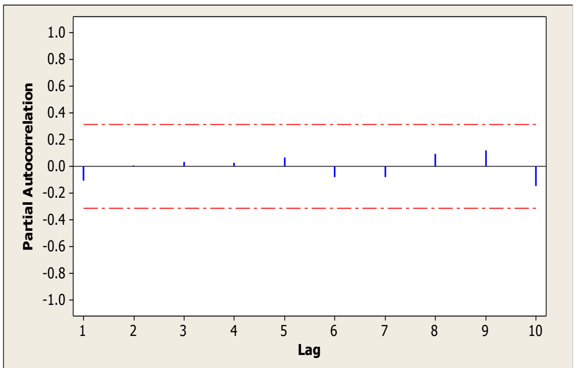

Fig 5: PACF of Residuals for Unemployment
(with 5% significance limits for the partial autocorrelations)

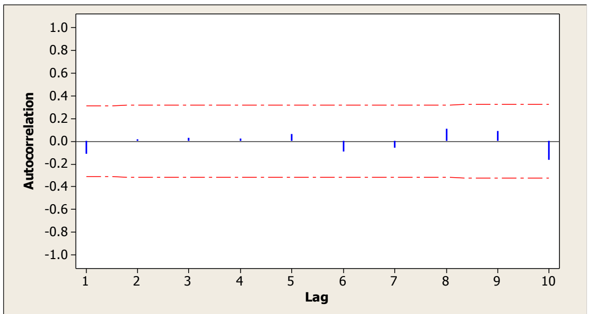

Fig. 4: ACF of Residuals for Unemployment
(with 5% significance limits for the autocorrelations)

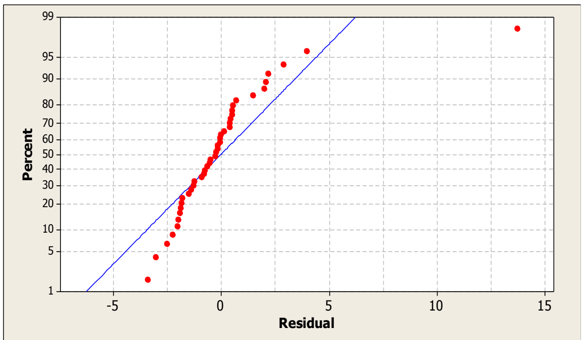

Fig 6: Normal Probability Plot of the Residuals
(response is Unemployment)